

ORIGINAL

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of

Amendment Of The Commission's Rules To
Establish A Next-Generation Air-Ground
Communications Service On A Secondary
Licensed Basis In The 14.0 to 14.5 GHz Band

RM - _____

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PETITION FOR RULEMAKING

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SUMMARY

This Petition for Rulemaking asks the Commission to establish a new communications service to provide broadband connectivity to aircraft flying within the continental United States. The Next-Generation Air-Ground (“Next-Gen AG”) mobile service proposed herein would operate on a secondary licensed basis at 14.0 to 14.5 GHz and use approximately 150 ground stations to provide 300 Gigabits per second (“Gb/s”) on a combined basis to airline passengers who want to – and increasingly *have to* – stay fully connected while traveling.

The need for such a Next-Gen AG service is clear. As the Commission well knows, mobile broadband usage is exploding. Consumers are embracing at unprecedented rates the remarkable capabilities of smartphones, tablets, e-readers, and other mobile broadband-enabled devices. Smartphones sales already are outpacing conventional PC sales, and, by 2015, tablets are expected to generate as much mobile broadband data traffic as the entire world generated in 2010. These personal, handheld devices are now an integral part of many Americans’ lives – especially the millions of American airline travelers and “road warriors,” in particular. Airline travelers increasingly need full access the same mobile broadband services and applications that they use on the ground. From social networking applications to multi-player gaming sites to online video delivery and music streaming services to storing and retrieving gigabytes of data from the cloud, American consumers today require anywhere/anytime broadband access, including when they are traveling for hours on an airplane above the continental U.S.

Current in-flight communication systems are either too expensive or data capacity limited and thus will be unable to support the increasing data demands of consumers. In contrast to the relatively low-cost terrestrial-based system proposed herein, satellite-based systems have much higher equipment costs and potentially crippling latency issues, and thus have been deployed with marginal success. Aircell’s terrestrial-based system, which is based on Qualcomm’s EV-

DO air-ground technology, is the most widely deployed and fastest growing aircraft communications system in use today; it is currently installed on more than 1,100 commercial aircraft and numerous private jets. The Aircell system, however, operates in just 3 MHz of spectrum and will have difficulty supporting the rapidly increasing demand for mobile broadband connectivity on-board aircraft as smartphones, tablets, and other mobile broadband devices continue to proliferate. For this reason, Qualcomm has designed a Next-Gen AG system that can support a very high level of demand and offer airline travelers an in-flight broadband experience equivalent to what is available in their homes, offices, parks, cars, buses, and trains.

The proposed Next-Gen AG system would operate in the Ku band at 14.0 to 14.5 GHz on a secondary licensed basis to, and in successful coexistence with, Geosynchronous Orbit (“GSO”) satellite systems (used to provide various services, including Qualcomm’s own OmniTRACS service), future Non-Geosynchronous Orbit (“NGSO”) satellite systems, NASA’s Tracking and Data Relay Satellite System (“TDRSS”), and radio astronomy users. Indeed, as an incumbent user of this band itself, Qualcomm has a direct interest in fully protecting incumbent operations. As described herein and detailed in Appendix A to this Petition, the Next-Gen AG system will fully protect current and potential future incumbent operations from harmful interference via highly advanced RF equipment and antenna designs, tightly-focused Ground Station communications beams that point north (away from the geostationary orbit), low transmit power from aircraft, and seamless hand-offs to successive Ground Stations that track the flight path. In this way, the new service will offer millions of airline travelers full broadband connectivity.

Accordingly, Qualcomm respectfully requests that the FCC swiftly issue a Notice of Proposed Rulemaking proposing to adopt the rules in Appendix B to this Petition and, as soon as possible thereafter, adopt the regulations and auction the spectrum on a secondary licensed basis for two Next-Gen AG systems, both using the technology described in this Petition.

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PETITION FOR RULEMAKING

QUALCOMM Incorporated hereby petitions the FCC to establish a Next Generation Air-Ground ("Next-Gen AG") terrestrial-based communications service to provide multi-gigabit per second broadband connectivity to aircraft flying within the continental United States. U.S. consumers' rapid adoption of smartphones, tablets, and other mobile broadband enabled wireless devices necessitate prompt Commission action to create this new mobile broadband communications service, so airline travelers can maintain the same level of broadband connectivity that they currently enjoy in their homes, offices, parks, cars, trains, and buses.

The Next-Gen AG system proposed herein would operate on a secondary licensed basis in the 14.0 to 14.5 GHz band and successfully protect incumbent satellite operations (which support various satellite-based services including Qualcomm's own OmniTRACS service) and other users via a series of innovative interference mitigation techniques and advanced equipment designs. Qualcomm proposes that the Commission would conduct an auction of two 250 MHz licenses at 14.00 to 14.25 GHz and 14.25 to 14.50 GHz to enable two separate systems, but not restrict a single entity from purchasing both licenses to construct a single, more robust, 500 MHz system. The proposed system would support communications between terrestrial ground stations

and aircraft, much like the current Aircell Air-Ground system,¹ but with significantly greater bandwidth to support the exponentially increasing data demands of today's consumers who require anywhere/anytime broadband access including when they are flying in a plane several miles above the surface of the earth.

This Petition for Rulemaking is comprised of two main sections and two supporting appendices. Section I below describes the need for a new mobile broadband communications service that can provide air travelers with the same level of broadband connectivity that is available to them from terrestrial services. It explains that consumers' rapid adoption of mobile broadband-enabled devices and applications cries out for the Next-Gen AG service proposed herein. Section II provides a detailed description of the Next-Gen AG system design and operational parameters, and a proposed licensing approach. Section II also contains a summary of the detailed technical interference analysis provided in Appendix A and provides an overview of the proposed Next-Gen AG service rules in Appendix B.

Qualcomm looks forward to working closely – and quickly – with the Commission and all interested stakeholders in a rulemaking proceeding to successfully introduce this advanced, and much needed, mobile broadband service to airline travelers, while fully protecting incumbent operations.

¹ Aircell's existing air-ground system uses Qualcomm's EV-DO technology pursuant to the regulations in Subpart G of Part 22 of the FCC Rules. *See* 47 C.F.R. §§ 22.801, *et seq.*

DISCUSSION

I. Consumer Adoption And Use Of Mobile Broadband Devices At Unprecedented Rates Are Driving The Need For A High-Data-Rate Air-Ground Communications System

“The world is going mobile.”² Consumers are adopting mobile broadband-enabled smartphones, tablets, e-readers, and other handheld computers faster than any other computing platform in the history of mankind.³ Deloitte’s Technology, Media and Telecommunication Group predicts that this year, the combined sales of smartphones, tablets and netbooks will exceed 400 million units worldwide, overtaking by many millions traditional PC sales. Indeed, many consumers today own multiple mobile broadband-enabled devices, and it is not at all uncommon to see an airline traveler carrying a smartphone, a tablet, and an e-reader.⁴

These powerful handheld devices have become integral to the personal and business lives of millions of American consumers who demand anywhere/anytime broadband access to: communicate with family via videoconference, watch entertainment programming, or store and retrieve from the cloud limitless amounts of data in the form of emails, documents, books, newspapers, magazines, photos, videos, music, and movies. Consumers are demanding that the same level of broadband access they have while on the ground be made available after they

² FCC Chairman Julius Genachowski, Prepared Remarks at the Telecommunications Industry Association 2011 Summit, Dallas, Texas (May 19, 2011) *available at* http://transition.fcc.gov/Daily_Releases/Daily_Business/2011/db0520/DOC-306768A1.pdf.

³ *See id.* (noting also that smartphone sales have eclipsed PC sales). *See also* “Smartphones, Tablets To Top PC Sales In 2011, Report Says,” HÜRRİYET DAILY NEWS (Feb. 16, 2011) (“More than 50 percent of computing devices sold globally in 2011 will not be PCs, according to Deloitte’s Technology, Media and Telecommunication Predictions report.”); Kristen Purcell, “E-Reader Ownership Doubles In Six Months,” PEW INTERNET & AMERICAN LIFE PROJECT (June 27, 2011) *available at* <http://pewinternet.org/Reports/2011/E-readers-and-tablets.aspx>.

⁴ *See The iPass Mobile Workforce Report, Year End Review and 2011 Predictions* (Dec. 9, 2010) *available at* <http://www3.ipass.com/wp-content/uploads/2010/12/Mobile-Workforce-Report-yearend-2010.pdf> (finding that nearly 97% of mobile employees carry two or more mobile devices and that nearly 50% carry three or more devices).

board an airplane. For the reasons detailed herein, Qualcomm believes that a Next-Gen AG service will become essential for a majority of U.S. air travelers within the next several years, and the FCC needs to act now to support the rapidly increasing mobile broadband data needs of these airline travelers and America's "road warriors."

A. Mobile Broadband-Enabled Device Sales Are Growing Exponentially

Sales of mobile broadband-enabled portable devices are skyrocketing.⁵ More and more airline passengers are carrying smartphones, tablet computers, e-readers, gaming devices, and notebook computers on-board aircraft, and increasing numbers of travelers are accessing the Internet via on-board Wi-Fi connections. Aircell, provider of the popular Gogo InFlight Internet service, estimates that more than 200 million people will travel on Wi-Fi enabled flights this year.⁶ Broadband usage on-board aircraft will continue to grow as portable device sales continue to skyrocket and consumers increasingly demand in-flight mobile broadband connectivity.

Almost 10 million tablet computers were sold worldwide during just the last three months of 2010.⁷ Research firm IDC forecasts that this year 44.6 million tablets will ship worldwide,

⁵ Cisco projects that by 2015 there will be more than 7 billion mobile connected devices worldwide, which will be nearly one device per person. See Cisco Visual Networking Index (VNI) Q&A: Global Mobile Data Traffic Forecast, 2010–2015 (Feb. 1, 2011) *available at* http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c_11-520862.html. See also Ryan Kim, "Google Sees 500,000 Android Devices Activated Everyday," GIGAOM (June 28, 2011) (number of Android devices being activated are increasing 4.4 % week over week); Elise Ackerman & Erico Guizzo, "The Mobile Web Will Be A Smarter Web," IEEE SPECTRUM, at 42 (June 2011).

⁶ See MDS and Aircell Press Release, *Over 200 Million People Set To Travel On Wi-Fi-Enabled Flights In 2011* (Apr. 13, 2011) *available at* <http://aircell.com/press-room/over-200-million-people-set-travel-wifi-enabled-flights-2011> (noting that Aircell's Gogo service is available today on more than 1000 aircraft, which is a significant increase since the 2008 launch of the service when just 15 domestic aircraft were equipped with the service).

⁷ Gregg Keizer, "iPad Lead Shrinks As Tablet Sales Grow, Android Tablets – Mostly Samsung's Galaxy Tab – Take 22% Share In Q4 2010, Erode Apple's Supremacy,"

which is more than two-and-a-half times the number that shipped in 2010; IDC expects worldwide tablet sales to exceed 70 million units in 2012.⁸ In the U.S. alone, Forrester Research estimates that there will be more than 50 million tablet users in 2012 and more than 82 million such users in 2015.⁹

Smartphone sales are even more remarkable. A recent Gartner study found that worldwide smartphone sales exceeded 100 million units in just the first quarter of this year.¹⁰ A second Gartner study estimated that smartphone sales in the U.S. will reach 95 million this year.¹¹ Moreover, Nielsen reported that, for the first time ever in May 2011, the sales of smartphones in the U.S. exceeded the sales of feature phones.¹² E-readers are another major

COMPUTERWORLD (Jan. 31, 2011) *available at* http://www.computerworld.com/s/article/9207319/iPad_lead_shrinks_as_tablet_sales_grow.

⁸ See *id.*

⁹ See Nick Bilton, "Tablet Sales to Spike in 2011, Forrester Says," NEW YORK TIMES (Jan. 24, 2011) *available at* <http://bits.blogs.nytimes.com/2011/01/04/tablet-sales-to-spike-in-2011-forrester-says/>.

¹⁰ See Gartner Research, *Gartner Says 428 Million Mobile Communication Devices Sold Worldwide in First Quarter 2011, a 19 Percent Increase Year-on-Year, Apple, Samsung and HTC Reported Strongest Results in an Increasingly Smartphone-Dominated Market* (May 19, 2011) *available at* <http://www.gartner.com/it/page.jsp?id=1689814>.

¹¹ See Gartner Research, *Gartner Survey Shows U.S. Consumers More Likely to Purchase a Smartphone Than Other Consumer Devices in 2011* (Feb. 17, 2011) *available at* <http://www.gartner.com/it/page.jsp?id=1550814>.

¹² See "In US, Smartphones Now Majority of New Cellphone Purchases," Nielsen.com (June 30, 2011) (55 percent of U.S. mobile consumers "who purchased a new handset in the past three months reported buying a smartphone instead of a feature phone, up from 34 percent just a year ago.") *available at* <http://blog.nielsen.com/nielsenwire/?p=28237>.

success story, and by some measures are outpacing tablet sales.¹³ Analytics firm In-Stat predicts that e-reader shipments will grow to 35 million units annually by 2014.¹⁴

Simply stated, sales of mobile-broadband enabled devices are exploding because they are improving consumers' personal lives and enabling countless business efficiencies.

B. Consumers Are Enthusiastically Embracing Online Applications And Services That Require Full-Time Broadband Connectivity

Consumers are taking full advantage of the many capabilities that are packed into today's mobile broadband enabled devices. Applications, or "apps," for smartphones and tablets are driving this growth. In contrast to traditional means of accessing information via the Internet, consumers are finding apps to be less time consuming than browsers and less complex than typical desktop/laptop computer software programs. Apps, by design, provide quick, anywhere/anytime, direct access to requested information – be it news, weather, email, newspapers, books, photos, games, videos, and movies, to name a few. As a result, smartphone users are consuming significantly more data than they were consuming just one year ago. In fact, the average smartphone user now consumes 435 MB per month, which is 89% more than the per month amount smartphone users consumed just one year ago.¹⁵

In many ways, smartphones and tablets have become an extension of today's American consumer. *More than one-third* of U.S. smartphone users interact with non-voice smartphone

¹³ See n.3, *supra*.

¹⁴ See Nicholas Kolakowski, "Mobile News, Amazon's Kindle with Ads Tops Sales Chart," EWEK.COM (May 16, 2011) available at <http://www.eweek.com/c/a/Mobile-and-Wireless/Amazons-Kindle-With-Ads-Tops-Sales-Chart-423990/>.

¹⁵ See Ina Fried, "Smartphone Users Continue to Gobble Data At a Staggering Rate," WALL STREET JOURNAL ALLTHINGS.D.COM (June 17, 2011) available at <http://allthingsd.com/20110617/smartphone-users-continue-to-gobble-data-at-a-staggering-rate/>. (based on Nielsen's analysis of cellular phone bills for smartphone owners, noting that the growth among the heaviest users has been even more astonishing).

applications *before they even get out of bed*.¹⁶ The most common activity is checking Facebook with 18 percent of smartphone users logging into the site while their heads are still on the pillow.¹⁷

Given that broadband-enabled smartphones and tablets are going beyond communication and entertainment, and entering the realm of common everyday activities and chores, consumers more and more will want to access the same mobile services and applications on-board airplanes.¹⁸ From social networking applications such as Facebook, to online video delivery services such as Hulu, Netflix and YouTube, to depositing and retrieving gigabytes of data stored in the cloud, consumers want – *and, in an increasing number of cases, need* – anywhere/anytime broadband access. As discussed below, social networking, video delivery services, and cloud computing applications will continue to be major drivers of mobile broadband usage over the coming years.

Social networking. By any measure, the growth of Facebook has been staggering, and there is no sign of it letting up. Facebook currently has more than a half billion users, 250 million of whom access the site via mobile devices.¹⁹ Facebook reports that those who access the social networking site on their mobile devices – to share updates, links, pictures, and

¹⁶ See *From Apps To Everyday Situations, An Ericsson Consumer Insight Summary*, Ericsson.com (2011) available at http://www.ericsson.com/res/docs/2011/silicon_valley_brochure_letter.pdf.

¹⁷ See *id.* (consumers were also found to check, first thing each morning, apps for news, weather, and the Craigslist classified ads site).

¹⁸ Indeed, American Airlines and Samsung recently announced that the premium cabins of 600 aircraft will be equipped later this year with Wi-Fi enabled Samsung Galaxy tablet computers. See Chloe Albanesius, “American Airlines Adding Samsung Galaxy Tab 10.1 Tablets to Flights,” PC MAGAZINE (June 14, 2011) available at <http://www.pcmag.com/article2/0,2817,2386894,00.asp>.

¹⁹ See Facebook Statistics (accessed May 27, 2011) available at <http://www.facebook.com/press/info.php?statistics> (Facebook’s users spend more than 700 billion minutes per month on the site).

videos, among other things – are twice as active as non-mobile users.²⁰ Not surprisingly, social networking is the fastest growing mobile app, experiencing a 240% increase from 2009 to 2010.²¹

Facebook also is developing means of allowing users to share their favorite music, entertainment programming and other media with friends – much like they share news stories, photos, and videos today.²² In addition, multi-player gaming applications, many of which need a low-latency connection (which would be provided by the Next-Gen AG system), are becoming increasingly popular.²³ Each of these uses will result in increased mobile broadband network traffic.

Video delivery services. Consumers are increasingly accessing entertainment programming via online services such as Hulu, Netflix, and YouTube, and these consumers will want to be able to access this programming on-board aircraft. In the U.S. today, Netflix is the single largest source of Internet traffic. The entertainment programming download service has achieved subscriber penetration of 28% in America with the average Netflix subscriber consuming more than 1 GB of data per day.²⁴

²⁰ See *id.*

²¹ See “The Rise of Facebook Mobile” (Sept. 29, 2010) *available at* <http://www.flowtown.com/blog/rise-of-facebook-mobile?display=wide>.

²² See Ben Sisario & Miguel Helft, “Facebook Is Developing Ways to Share Media,” *NEW YORK TIMES* (May 26, 2011) *available at* <http://www.nytimes.com/2011/05/27/technology/27facebook.html>.

²³ See Scott Steinberg, “Top 3 Gaming Trends From E3 2011,” *MASHABLE.COM* (June 10, 2011) *available at* <http://mashable.com/2011/06/10/e3-2011-trends/> (“As Internet connectivity continues to proliferate, bandwidth increases, mobile devices boom and the quality, sophistication and availability of on-demand gaming improves, the humble web browser — increasingly available on smartphones, tablets, PCs, TVs, consoles and other devices — may soon become the most popular, and ubiquitous, video game system of all.”).

²⁴ See Sandvine Intelligent Broadband Networks, “Global Internet Phenomena Spotlight, Netflix Rising” (May 18, 2011) *available at*

YouTube use also is growing rapidly. The service delivers more than 3 billion video views to broadband consumers every day. The YouTube service also is remarkable for it is one of the largest sources of data uploads. More than 48 hours – two full-day’s worth – of video is uploaded to the site every single minute, which is double the amount of content that was uploaded per minute last year.²⁵

Cloud computing is one mobile broadband application that would generate much more mobile data traffic than even video delivery services, if current estimates hold.²⁶ A Gartner survey of more than 2,000 Chief Information Officers found that they expect to adopt cloud-based services much faster than originally expected. While only 3% of CIOs had the majority of their information technology (“IT”) running in a cloud-based system at the beginning of 2011, the surveyed CIOs expect that number to increase to 43% by 2015.²⁷

Spending on public IT cloud services (*i.e.*, those made available to the general public) are expected to grow from \$21.5 billion in 2010 to nearly \$73 million in 2015.²⁸ Microsoft recently

http://www.sandvine.com/downloads/documents/05-17-2011_phenomena/Sandvine%20Global%20Internet%20Phenomena%20Spotlight%20-%20Netflix%20Rising.pdf.

²⁵ See Peter Kafka, “YouTube Is Six Years Old and Huge: Three Billion Views a Day” WALL STREET JOURNAL ALLTHINGS.D.COM (May 25, 2011) *available at* <http://allthingsd.com/20110525/youtube-is-6-years-old-and-huge-3-billion-views-a-day/>.

²⁶ See Gartner Research, *Gartner Executive Programs Worldwide Survey of More Than 2,000 CIOs Identifies Cloud Computing as Top Technology Priority for CIOs in 2011, Survey Results Show Business Leaders Looking for IT to Drive Revenue Growth* (Jan. 21, 2011) *available at* <http://www.gartner.com/it/page.jsp?id=1526414>.

²⁷ See *id.*; see also Geoffrey A. Fowler, “Disney CEO: The Cloud Will Improve Digital Entertainment,” WALL STREET JOURNAL – WSJ BLOGS (June 2, 2011) *available at* <http://blogs.wsj.com/digits/2011/06/02/disney-ceo-the-cloud-will-improve-digital-entertainment/> (“cloud storage, or keeping movies, TV shows and songs on the Internet instead of local computers and devices, is ‘very real, very apparent very soon.’”).

²⁸ See IDC Press Release, *Public IT Cloud Services Spending to Reach \$72.9 Billion in 2015, Capturing Nearly Half of Net New Spending Growth in Five Key Product Segments*, (June

announced a cloud-based version of its well-known Office suite of software to compete with the successful Google Docs cloud-based software collection, which currently boasts 30 million users.²⁹ Given these activities, mobile network operators are moving quickly to support consumers' and businesses' ability to access applications from cloud-based networks in place of their own data centers.³⁰

Federal, state, and city governments also are moving to cloud-based approaches for IT management as a means of lowering software maintenance costs and ensuring timely software updates.³¹ The U.S. General Services Administration believes that its IT team can use cloud computing to better manage services, projects, products, people, and financials through any Internet browser and any device.³² These migrations to the cloud will generate greatly increased mobile data traffic and heighten the need for thousands of federal government workers to have reliable broadband connections wherever they are, including in-flight.

20, 2011) ("The United States will dominate overall spending throughout the forecast period, with nearly 50% of all public IT cloud services revenues coming from the U.S. in 2015.").

²⁹ See Steve Lohr, "Microsoft Takes to Cloud to Ward Off Competition," NEW YORK TIMES (June 27, 2011) *available at* <http://www.nytimes.com/2011/06/28/technology/business-computing/28soft.html?ref=business-computing>.

³⁰ See Jon Brodtkin, "Terremark-Verizon Cloud Service Ready To Go, Enterprise and Network Capabilities Mesh After Acquisition," NETWORK WORLD (June 23, 2011) *available at* <http://www.networkworld.com/news/2011/062311-verizon-terremark.html>.

³¹ See Elizabeth Montalbano, "Wyoming Completes Google Apps Migration, Days prior to Microsoft's Office 365 launch, the first state government to drop its in-house software in favor of Google's cloud-computing offering announced that all 10,000 employees have made the move" INFORMATIONWEEK (June 22, 2011) *available at* <http://www.informationweek.com/news/government/state-local/231000229> (noting that the U.S. Departments of Agriculture and Interior, California, Minnesota, and Wyoming, as well as Los Angeles, New York City and San Francisco have moved to cloud-based software systems).

³² See Rutrell Yasin, "GSA Plans Its Next Big Step Into The Cloud, Agency Looking For A Provider For Enterprise IT Management Services," GOVERNMENT COMPUTER NEWS (May 26, 2011) *available at* <http://gcn.com/Articles/2011/05/26/GSA-Enterprise-IT-Management-Cloud.aspx?Page=1>.

With regard to personal computing, Forrester Research estimates that 196 million U.S. consumers will be using a personal cloud service by 2016.³³ In this regard, Amazon, Apple and Google also recently introduced cloud-based music services.³⁴ These services, which will allow users to stream music from their private accounts to a multitude of portable devices, will require reliable mobile broadband connectivity and generate greatly increased traffic demands. Finally, two other fast growing cloud computing services, although they are not typically considered as such, are Google Docs (and Gmail, calendar, photos, etc.) and, of course, Facebook.

The successful growth of mobile broadband devices embedded with business software applications and music/movie/television -streaming services is a major reason why the FCC itself has projected that growth in mobile data usage will soar by more than 35 times by 2014.³⁵ To support this unprecedented growth in demand, the FCC estimates that at least 275 MHz of additional licensed terrestrial mobile broadband spectrum should be made available by 2014 – an

³³ See Forrester Research, “The Personal Cloud: Transforming Personal Computing, Mobile, and Web Markets” (June 6, 2011) *accessible at* http://www.forrester.com/rb/Research/personal_cloud_transforming_personal_computing%2C_mobile%2C_and/q/id/57403/t/2.

³⁴ See Walter Mossberg, “For a Song, Online Giants Offer Music in a Cloud,” WALL STREET JOURNAL (May 19, 2011) *available at* http://online.wsj.com/article/SB10001424052748703509104576331333053784662.html?mod=djemTECH_h; Ben Sisario, “Deals Move Apple Closer to Streaming Music,” NEW YORK TIMES (June 2, 2011) *available at* <http://mediadecoder.blogs.nytimes.com/2011/06/02/deals-move-apple-closer-to-streaming-music/?ref=technology>. Kristen Schweizer, “Best Buy Expands Cloud-Based Online Music Platform to U.S., Supplier Says,” BLOOMBERG.COM (June 17, 2011) *available at* <http://www.bloomberg.com/news/2011-06-17/best-buy-expands-cloud-based-online-music-platform-to-u-s-supplier-says.html>.

³⁵ See *Mobile Broadband: The Benefits Of Additional Spectrum*, FCC OBI Technical Paper No. 6 (Oct. 21, 2010) at 9 (when compared to 2009 mobile broadband data usage levels). See generally FCC National Broadband Plan (Mar. 16, 2010).

amount of spectrum that the agency itself acknowledges still may be insufficient.³⁶ Additionally, a recent Cisco mobile traffic study projects that by 2015: (i) the aggregate traffic generated by smartphones will be 47 times greater than it is today; and (ii) the aggregate traffic generated by mobile broadband-enabled tablets will be equal to the amount of traffic that the entire worldwide mobile broadband network generated in 2010.³⁷

These extraordinary trends not only demonstrate the pressing need for the FCC to quickly work with the Administration and Congress to ensure that terrestrial mobile broadband spectrum resources needed to support this demand are identified and auctioned within the next few years, but also that the FCC needs to act swiftly on this Petition to establish a Next-Gen AG service to provide a similar broadband experience on-board aircraft. The United States can lead the way globally and become the first country to authorize such a mobile service so Americans can access their data whenever and wherever they may be including on a coast-to-coast flight. As FCC Chairman Genachowski has explained, broadband is a core driver of “our economy and our global competitiveness [and] a core accelerator for job growth.”³⁸ Enabling the Next-Gen AG service proposed herein will help to continue this economic engine of growth and virtuous cycle of mobile broadband innovation.

Finally, if the FCC needed any further validation of the need for a Next-Gen AG system, American Airlines and Samsung recently announced that the premium cabins of 600 aircraft will

³⁶ See FCC OBI Technical Paper No. 6, at 17-19 (“Even with the conservative set of assumptions used in this model, it is apparent that the nation faces the prospect of a spectrum shortage within the next five years.”)

³⁷ See n.5, *supra*, Cisco *Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015*, at 2-3,.

³⁸ Chairman Genachowski, “The Clock is Ticking,” Remarks on Broadband at the Mobile Future Forum (Mar. 16, 2011) at 2.

be equipped later this year with Wi-Fi enabled Samsung Galaxy tablets.³⁹ Airline passengers will use the tablets in-flight to access entertainment, social networking, and gaming applications and business travelers will be able to email, create, review, and edit documents, presentations, photos and audiovisual material. Given that these tablets ostensibly will be supported by Aircell's current, bandwidth-limited air-ground service, it won't be long until the much-higher capacity Next-Gen AG system proposed herein becomes absolutely essential.

II. A Next-Generation Air-Ground Mobile Broadband Communications System

Qualcomm has designed a Next-Gen AG mobile broadband communications system to operate in the Ku band at 14.0 to 14.5 GHz on a secondary licensed basis to geosynchronous ("GSO") satellite systems, future non-geosynchronous ("NGSO") satellite systems, NASA's Tracking and Data Relay Satellite System ("TDRSS"), and radio astronomy users. The proposed system has been meticulously engineered to successfully co-exist with these users. Qualcomm itself uses this Ku band spectrum for its own successful GSO satellite-based OmniTRACS mobile communications and information service, which has been operating in this band for well over two decades. Accordingly, the company has a direct, vested interest in fully protecting primary GSO satellite operations.

As described below and as detailed in Appendix A, the Next-Gen AG system protects current and potential future operations from harmful interference via: (i) highly advanced RF equipment and antenna designs; (ii) tightly-focused Ground Station ("GS") communications beams that point north (*i.e.*, away from GSO satellites); (iii) low transmit power from aircraft, and (iv) seamless hand-offs to successive GSs that track the flight path. In this way, the system proposed herein will provide millions of airplane travelers with high-speed in-flight broadband

³⁹ See n.18, *supra*, "American Airlines Adding Samsung Galaxy Tab 10.1 to Flights."

connectivity and fully protect primary users and successfully coexist with other secondary users of the 14.0 to 14.5 GHz band.

A. Next-Gen Air-Ground System Design, Operation, And Capabilities

The Next-Gen AG system will provide a high-data-rate backhaul communications link between in-flight aircraft and approximately 150 GSs – each operating with a maximum of four beams in a given swath of spectrum to track up to 600 in-flight aircraft above the Continental United States (“CONUS”). As designed, a single 500 MHz system could support an aggregate throughput of 300 Gigabits per second (“Gb/s”). If the Commission allocates, auctions, and authorizes the spectrum in two 250 MHz blocks, as discussed below, the aggregate throughput for each system would be halved, to approximately 150 Gb/s.

As proposed, the GS-aircraft links would use a Time-Division-Duplex communications scheme to provide a two-way backhaul connection to aircraft equipped with on-board Wi-Fi access points to interface wirelessly with passenger smartphones, tablets, laptops, gaming devices, and other Wi-Fi capable devices. While in-flight, passengers with these handheld devices could connect to the Internet via a 2.4 GHz or 5 GHz Wi-Fi connection or perhaps even via a higher-data-rate unlicensed connection that operates in the 60 GHz band.⁴⁰

⁴⁰ See *Qualcomm Atheros and Wilocity Announce Tri-band Wi-Fi: Industry's First Standards-compliant, Multi-gigabit Wireless Chipset, Qualcomm Atheros AR9004TB Solution Adds In-room 5 Gbps Performance to Industry Leading Wi-Fi Technology* (May 31, 2011) available at <http://www.qualcomm.com/news/releases/2011/05/31/qualcomm-atheros-and-wilocity-announce-tri-band-wi-fi-industry-s-first-stan> (announcing the release of the industry's first tri-band Wi-Fi chipset that integrates the multi-gigabit performance of in-room 60 GHz operations with handoffs to 2.4 and 5 GHz Wi-Fi connections); *Qualcomm Atheros Announces Highly Integrated Connectivity Solution for Superior Performance in Smartphones and Tablets, WCN3660 Combo Chip Brings Dual-band Wi-Fi, Bluetooth and FM Radio Connectivity to Qualcomm's 28nm Snapdragon Family of Mobile Processors* (May 31, 2011) available at <http://www.qualcomm.com/news/releases/2011/05/31/qualcomm-atheros-announces-highly-integrated-connectivity-solution-superior>.

1. Continental U.S. Coverage Via An Overlapping Hexagonal Grid Of Highly Sophisticated Ground Stations

As shown in Figure 1 below, the terrestrial component of the Next-Gen AG system is comprised of an arrangement of roughly 150 GS service areas that take the form of hexagonal regions and cover the CONUS. Each GS is located in the southern corner of a hexagonal service area and radiates northward – typically $\pm 60^\circ$ from true north and generally with a low elevation angle such as 10° or less – both of which enable the system to avoid interference to GSO satellite receivers on the GEO-arc. This operational mode translates into each GS serving aircraft flying primarily within the 120° arc on its north side and between 60 km and 300 km from the GS. See Figure 1. Aircraft flying within 60 km of a GS, which could be served by that GS via an elevation angle higher than 10° will be served in most cases by one of the neighboring GSs on either the southwest or southeast side of the GS (at an elevation angle below 10°). The choice of which neighboring GS to hand-off the signal to will depend on the aircraft's direction of travel.

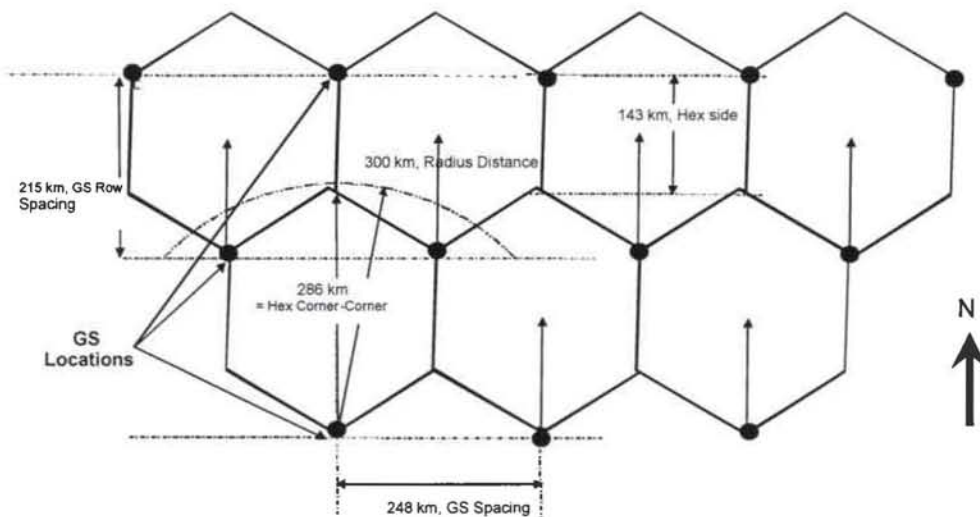


Figure 1. Next-Gen AG Ground Station Configuration

An important design element is the GS antenna's isoflux pattern in elevation, which allows the antenna gain of the GS to decrease in direct proportion to its distance from the

aircraft. As the aircraft approaches a GS and the elevation angle between the plane and GS increases, the transmit power for the GS-to-aircraft forward link is reduced in accordance with the diminished path loss to maintain a constant Carrier-to-Noise (“C/N”) ratio.

While the angular coverage range of a GS is nominally $\pm 60^\circ$ from true north, it may be slightly larger in practice to ensure that aircraft communications to/from one GS are successfully handed off to a neighboring GS. Also, the southernmost row of GS sites, which will be placed near the southern U.S. border, will serve a limited number of aircraft flying at azimuth angles slightly larger than $\pm 60^\circ$ from the GS by limiting the EIRP of the serving beam to avoid interference to GSO satellite operations. In certain cases, the data rate to aircraft very close to the southern U.S. border may need to be reduced in order to keep GS transmit EIRP levels low to maintain interference-free communications. Sufficient throughput to these aircraft flying close to the southern U.S. border will be maintained by allocating greater transmission time to them.

Accordingly, as explained above, all GS transmit beams point away from the GEO-arc, implement an isoflux pattern in elevation, and can lower transmit power levels when serving aircraft close to the southern U.S. border, so that signal levels seen beyond the aircraft remain well below the GSO satellite noise floor.

2. Serves Airline Passengers’ Information, Entertainment and Business Communications Needs

The proposed Next-Gen AG system is intended solely to be used to support mobile broadband communications connectivity to airplane passengers for purposes of accessing entertainment programming, personal and business email and attachments, IT services, cloud computing or social networking services. The system is not designed nor intended to be used in

any way for aviation navigation, air-traffic control communications, safety-of-life services, nor any other similar type of service covered by Part 87 of the Commission's rules.⁴¹

B. The 14.0 to 14.5 GHz Band Offers An Optimal Spectrum Sharing Environment

1. The Next-Gen Air-Ground System Will Successfully Share Spectrum With GSO Satellite Users, Future NGSO Satellite Users, As Well As TDRSS And Radio Astronomy

The proposed Next-Gen AG system would operate on a secondary licensed basis in a spectrum band that currently is allocated on a primary basis to (and heavily occupied by) GSO satellite (earth-to-space) communications – and includes both fixed and mobile systems, such as earth stations on vessels (“ESVs”) and vehicle mounted earth stations (“VMESs”).⁴² The band is allocated for use by NGSO satellite operations, but to Qualcomm's knowledge, there are no active NGSO licenses. In addition, the band is used by NASA's Tracking and Data Relay Satellite System (“TDRSS”) and for the Radio Astronomy Service.⁴³

Appendix A of this Petition contains a detailed technical analysis showing that the Next-Gen AG system will not interfere with GSO operations or cause harmful interference to potential NGSO operations, TDRSS, or radio astronomy. Appendix A also explains the Next-Gen AG system has been designed to operate successfully in the face of potential harmful interference from these other users.

⁴¹ See 47 C.F.R. § 87.1 *et seq.*

⁴² See 47 C.F.R. § 2.106, Table of Frequency Allocations, *and see* Footnotes NG183, NG184, US203 & US342. See also National Telecommunications and Information Administration, Office of Spectrum Management Federal Spectrum Use Summary, 30 MHz – 3000 GHz (June 21, 2010).

⁴³ Qualcomm expects that the Next-Gen AG system operator would enter into coordination agreements with NASA relating to protection of TDRSS and with the NSF relating to protection of radio astronomy services similar in form to the coordination agreements cited in Appendix A, n.51 and n.53, *infra*. Protection of the Radio Astronomy Service in the United States will be in accordance with US203 and US342 of 47 C.F.R. § 2.106.

Qualcomm has designed the Next-Gen AG system from the ground up to mitigate the impact of any potential interference from or to the system. As described above in Section II.A, all GSs will point to the north to limit any interference to GSO satellite systems well below required levels. In addition, all GSs will have high antenna gain to permit aircraft to transmit at very low power levels. GS antennas will implement an isoflux pattern in elevation angle (as described above and in Appendix A) to protect against potential interference into satellite receivers.

Furthermore, Next-Gen AG equipped aircraft will use directional receive antennas to reduce the GS transmit power needs. The aircraft antennas also will be located on the belly of the aircraft and be pointed at very low angles, *i.e.*, -5° from horizon. These mechanisms will work in concert to limit the potential for interference into GSO and NGSO satellites.

Finally, the Next-Gen AG system will hand-off aircraft communications to successive GSs that track the aircraft's flight path and in this way work in a manner similar to terrestrial cellular networks. These aircraft communications handoffs will allow the system to operate successfully through using the least amount of transmit power to maintain a desired Carrier-to-Noise interference ratio and a negligible $\Delta T/T$ (also referred to as Rise over Thermal) level into GSO satellite operations below 1% in all scenarios including worst case scenarios.

2. The FCC Can Auction Two 250 MHz Licenses But Permit A Single Entity To Hold Both Licenses And Deploy A More Robust System

Qualcomm respectfully requests that the Commission amend the U.S. Table of Frequency Allocations in Section 2.106 of the FCC Rules to add a secondary licensed mobile allocation in the 14.0 to 14.5 GHz band. In addition, Qualcomm proposes that FCC auction two separate secondary mobile licenses for the Next-Gen AG system at 14.00 to 14.25 GHz and 14.25 to

14.50 GHz, but allow a single entity to own both licenses and deploy a single, more robust system in 500 MHz of spectrum if supported by business considerations.

The 14 GHz uplink band has well developed and internationally recognized criteria to limit interference into satellites. These criteria allowed Qualcomm to calculate the worst case interference potential into GSO satellites and provide $\Delta T/T$ (or Rise over Thermal “ROT”) noise levels from the proposed Next-Gen AG into uplink of GSO satellites that are significantly less than the levels adjacent satellites are allowed.

Qualcomm sought to design a Next-Gen AG system that would replicate for the airline traveler, as closely as possible, a terrestrial broadband experience and, for all the reasons set forth in Section I of this Petition, support America’s rapidly increasing mobile broadband data demands. Thus, Qualcomm sought to design a system that would operate in a considerably-sized spectrum block, *e.g.*, approximately 500 to 750 MHz.

This bandwidth requirement forced Qualcomm to study frequency bands above 5 GHz because such a large block of spectrum is not available below that mark. At the same time, Qualcomm examined bands below 16 GHz because it found that bands above 16 GHz would be unsuitable due to both higher equipment costs and the substantial challenges that rain attenuation brings to providing a consistent, high-quality level of air-ground broadband service. Qualcomm also knew that a frequency band close to 5 GHz would make it quite costly to build GS antennas, and make aircraft transceiver equipment unduly large and heavy – all major considerations for aircraft operators. In addition, Qualcomm sought to avoid bands where there exists significant terrestrial point-to-point or point-to-multipoint operation, for such operations posed substantial challenges to interference-free air-ground communications. Moreover, the system could not operate in an unlicensed band because of the need to use higher transmit power than is permitted

in any existing unlicensed band and the concomitant need for certainty as to the other users in the band to avoid interference.

These considerations, *in toto*, led Qualcomm to the 14.0 to 14.5 GHz band, which is occupied by GSO satellite operations (and by TDRSS and radio astronomy in readily-identifiable areas of the CONUS and limited portions of the band) and provides a feasible sharing environment for the proposed system. For the reasons explained above and as detailed in Appendix A, the proposed Next-Gen AG system will successfully co-exist with all other users of the 14 GHz band.

Although the 14.0 to 14.4 GHz portion of the 14.0 to 14.5 GHz band is not currently allocated for mobile use in the U.S. (or in any ITU Region) as proposed herein, the FCC is able to amend the U.S. Table of Frequency Allocations to add a secondary allocation consistent with the ITU Radio Regulations,⁴⁴ and the agency has done so in the past.⁴⁵ As a matter of both FCC law and policy and ITU regulations, the issue is the same: Whether the proposed secondary service causes harmful interference to a primary service. Qualcomm conclusively demonstrates herein that the proposed secondary service will not interfere with primary services – even GSO satellite operations that are licensed to other countries – and thus is consistent with ITU

⁴⁴ See ITU Radio Regulations No. 4.4 (permitting the FCC to make frequency assignments that deviate from the International Table of Frequency Allocations, provided that “such a station, when using such a frequency assignment, shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with ... [ITU] Regulations”). See also NTIA Manual Of Regulations And Procedures For Federal Radio Frequency Management (Sept. 2009 rev.), § 4.1.3 Federal Table of Frequency Allocations (same) available at <http://www.ntia.doc.gov/osmhome/redbook/Manual.pdf>.

⁴⁵ The FCC added the Radionavigation service on a co-primary basis in the 24.75-25.05 GHz band although it does not exist in any ITU Region. Also, the federal government has Mobile Satellite Service secondary allocations in the 7 and 8 GHz bands although they do not exist in any ITU Region. See 47 C.F.R. § 2.106.

Regulations.⁴⁶ Appendix A to this Petition shows that the Next-Gen AG service will introduce much less than a 1% $\Delta T/T$ (or ROT) increase to any satellite in the GEO-arc covering the U.S., including any satellites located at the far west or east of the GEO-arc above the U.S. and satellites authorized by other countries. In fact, Qualcomm's interference analysis does not depend in any way on the ownership, origin, or number of GSO satellites over the Americas – they all will be protected to well under the 1% Rise over Thermal level.

**C. The Proposed Rules Will Enable Next-Generation
Air-Ground Communications And Fully Protect Primary Operations**

Appendix B to this Petition presents proposed rules for the Next-Gen AG service. Appendix B first proposes amending the FCC's Table of Frequency Allocations to add a secondary licensed mobile allocation at 14.0 to 14.5 GHz for the new mobile broadband communications service. Next, relying upon the methodical interference analysis in Appendix A, Qualcomm proposes that the aggregate Rise over Thermal ($\Delta T/T$) from the Next-Gen AG system into the uplink of GSO satellites shall not exceed 1%. The proposed 1% Rise over Thermal requirement is a performance-based rule intended to provide the Next-Gen AG system designer with the necessary flexibility to deploy a robust system. Finally, the proposed rules include an out-of-band emissions requirement that would apply if the FCC were to authorize two separate Next-Gen AG systems in the 14.0 to 14.5 GHz band.

⁴⁶ See ITU Radio Regulations, Art. 5, § 2 (secondary service stations shall not interfere with stations of primary services that are currently assigned or may be assigned, but may be protected from stations of the same or other secondary services).